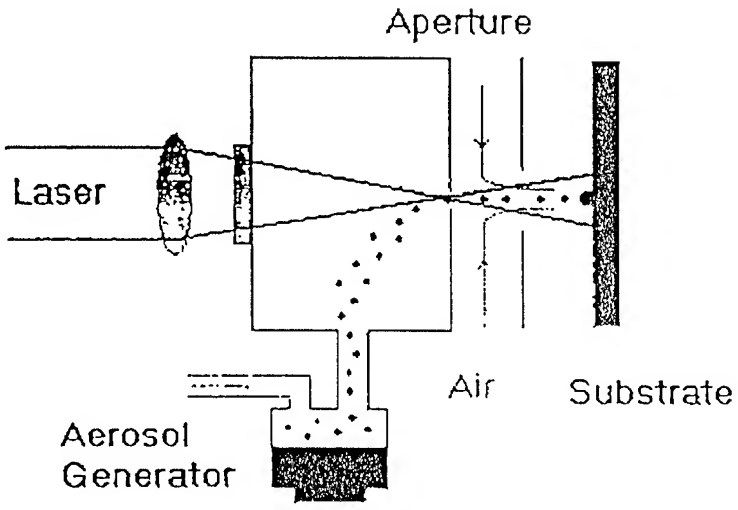

Fig. 1.

Features

- *High Velocity (~10m/s)*
- *Variable Beam Diameter (10 μm)*
- *High Throughput (~ 10^9 s^{-1} in 100μm beam)*
- *Reduced Clogging*
- *Long Working Distance (~ few cm)*
- *Simultaneous Laser Treatment*

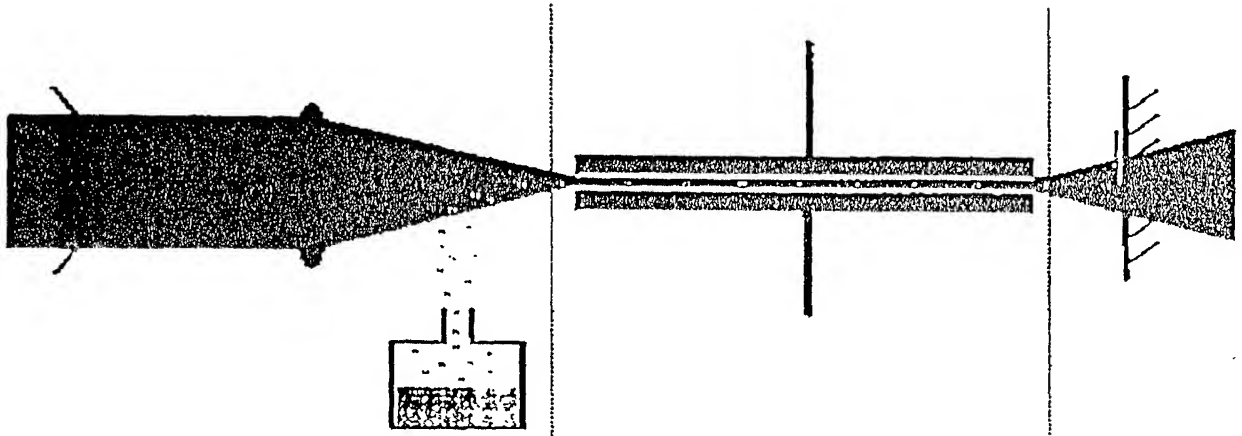

Fig. 2.

Aerosol Generation	Particle Delivery	Laser Processing
Features		
• *Small droplets (~1 μm)*	• *Accuracy to 3 μm*	• *Low power (~ 50 mW)*
• *Dense aerosols (~10 ^{16} m^3)*	• *Single particle to 10^9 particles/s*	• *High scan rate (~1 m/s)*
	• *Throughput to 0.25 mm^3/s*	- *Dense, conductive materials (ρ~2x bulk)*

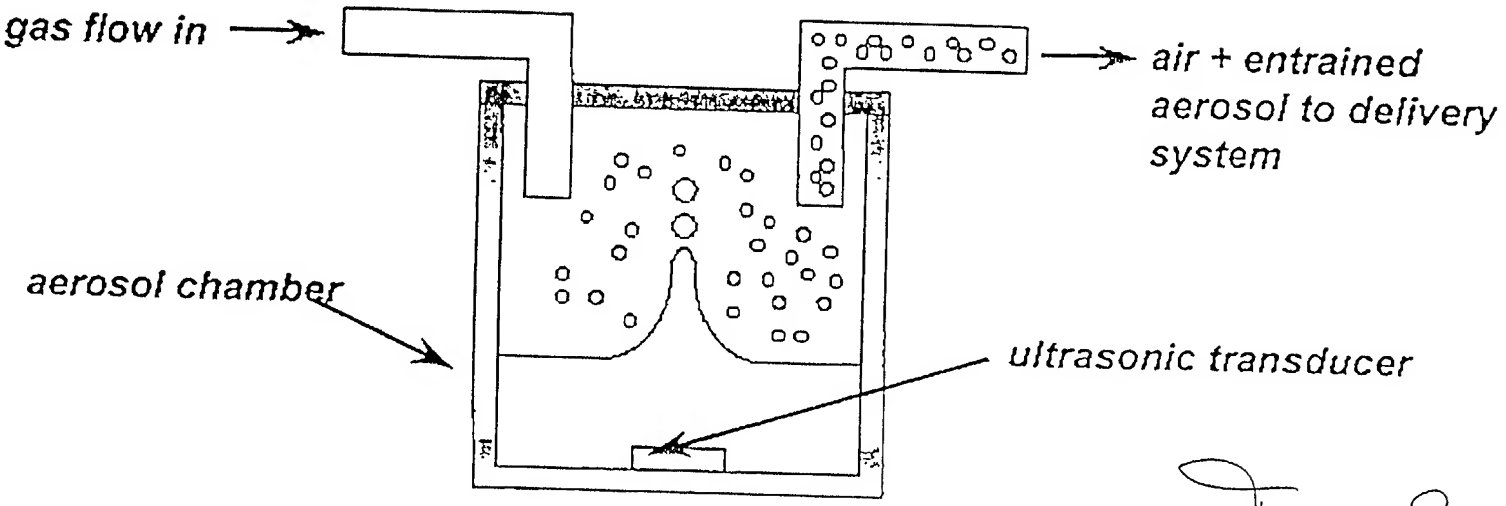

Fig. 3.

- *Small droplets (~1 μm, 1 fL)*
- *Dense aerosols (~10^{16} m^3)*
- *100 μL minimum sample*
- *All solids, all precursors, or solid/precursor mixtures*
- *Precursor based alloys with atomic scale mixing*
- *Organic and biological entities in droplets (enzymes, proteins, virus, etc.)*

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Fig. 4.

Air Jet

[redacted]

Compressed AirJet

[redacted]

- Large Particles (1-30 μm)
- High Viscosity Fluids
- Particles + Precursor binder
- Animal Cells + Media
- Bacteria
- Virus

Particulate in Suspension

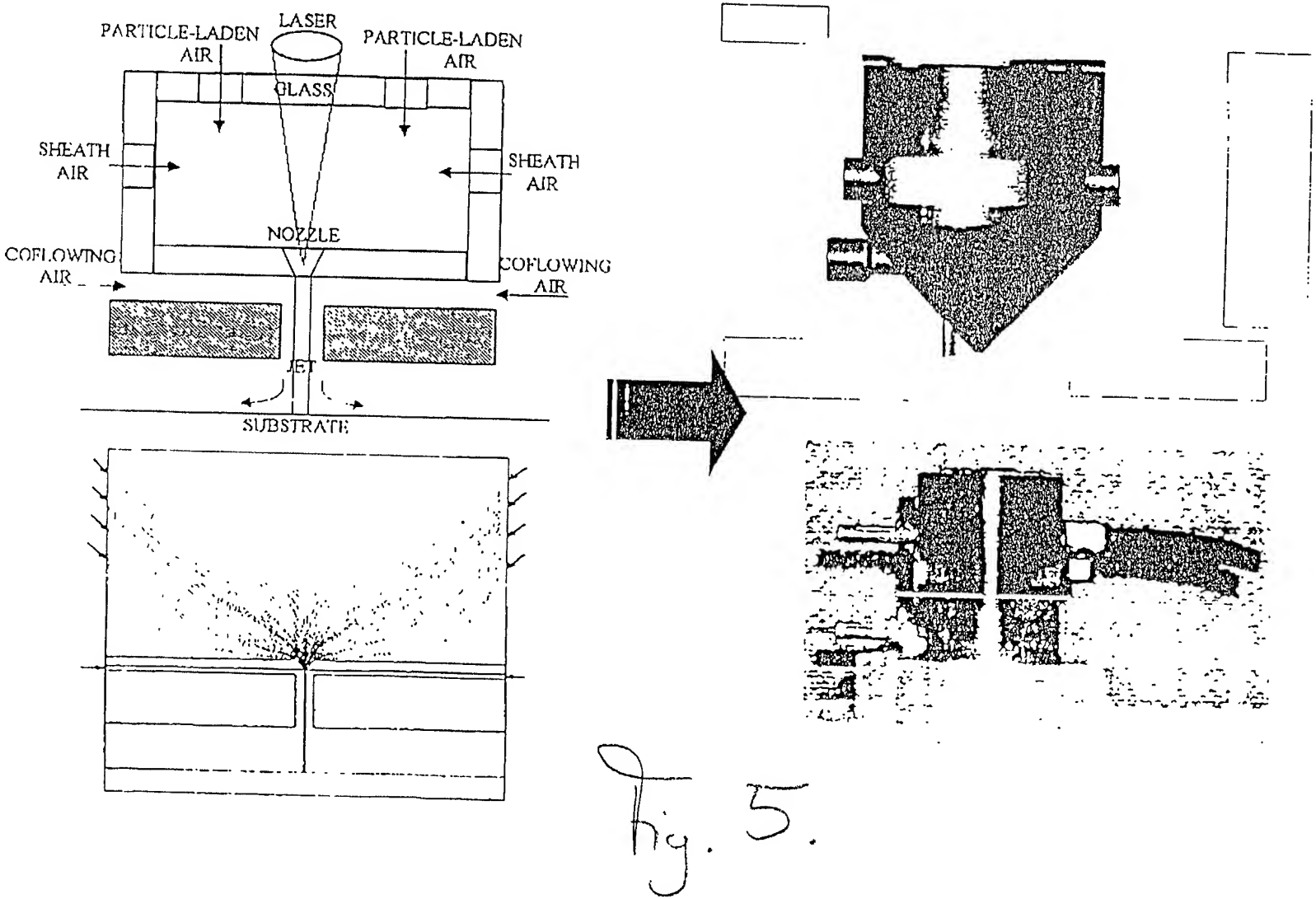

PARTICLE-LADEN AIR
LASER
PARTICLE-LADEN AIR
GLASS
SHEATH AIR
SHEATH AIR
NOZZLE
COFLOWING AIR
COFLOWING AIR
JET
SUBSTRATE

Fig. 5.

Cascade Impaction

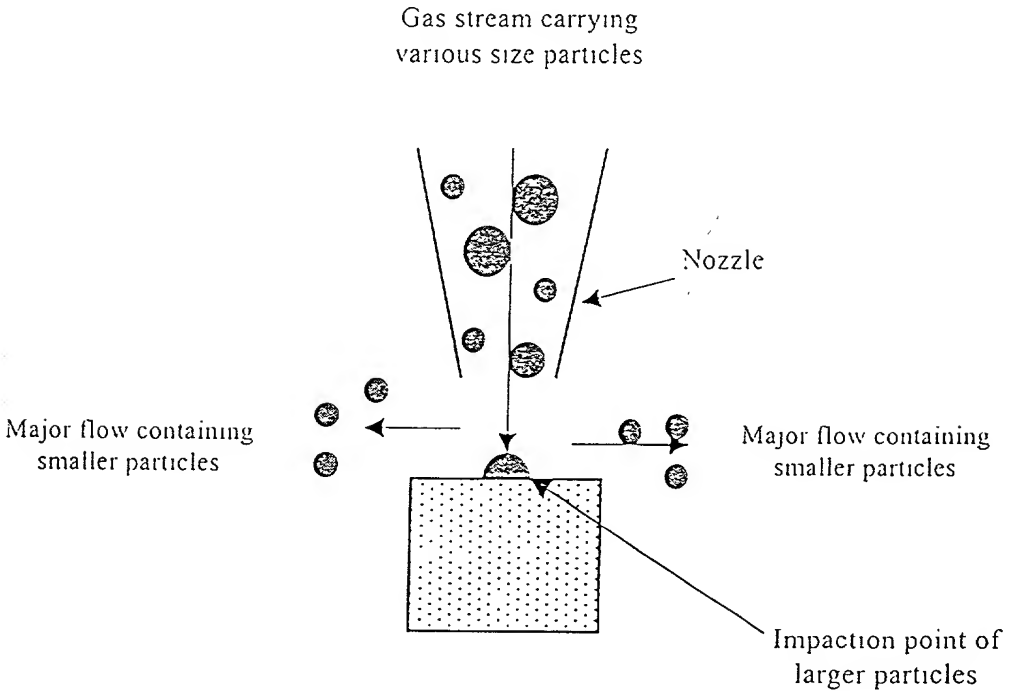


Fig. 6.

Virtual Impactor

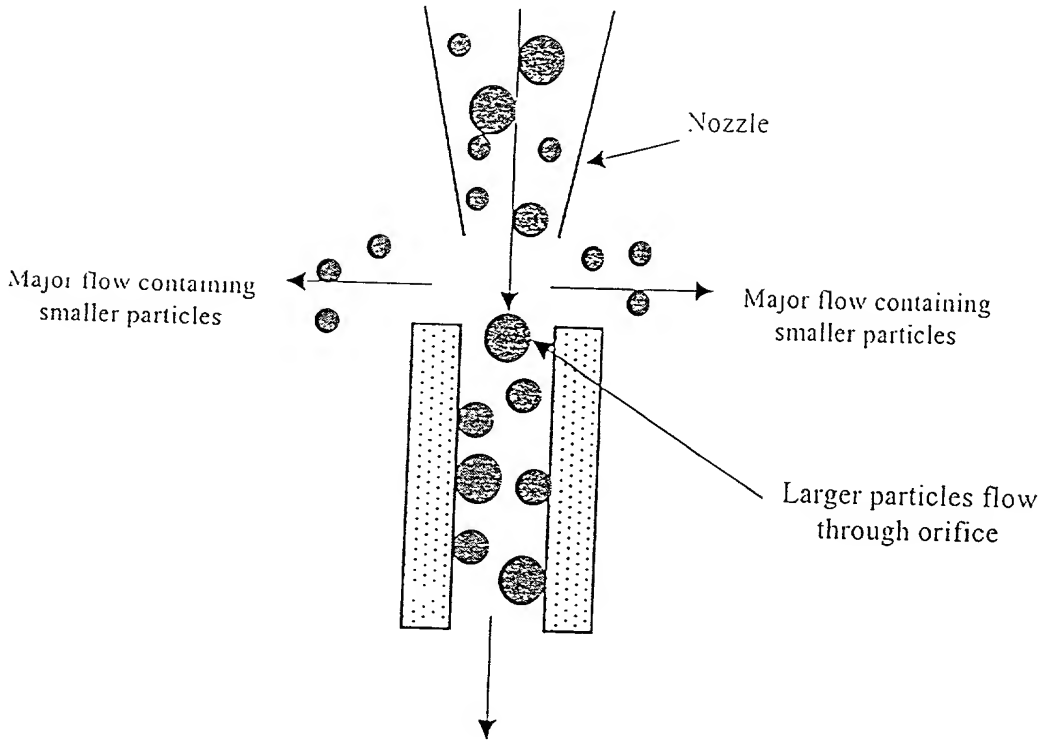


Fig. 7.

Virtual Impactors in Series

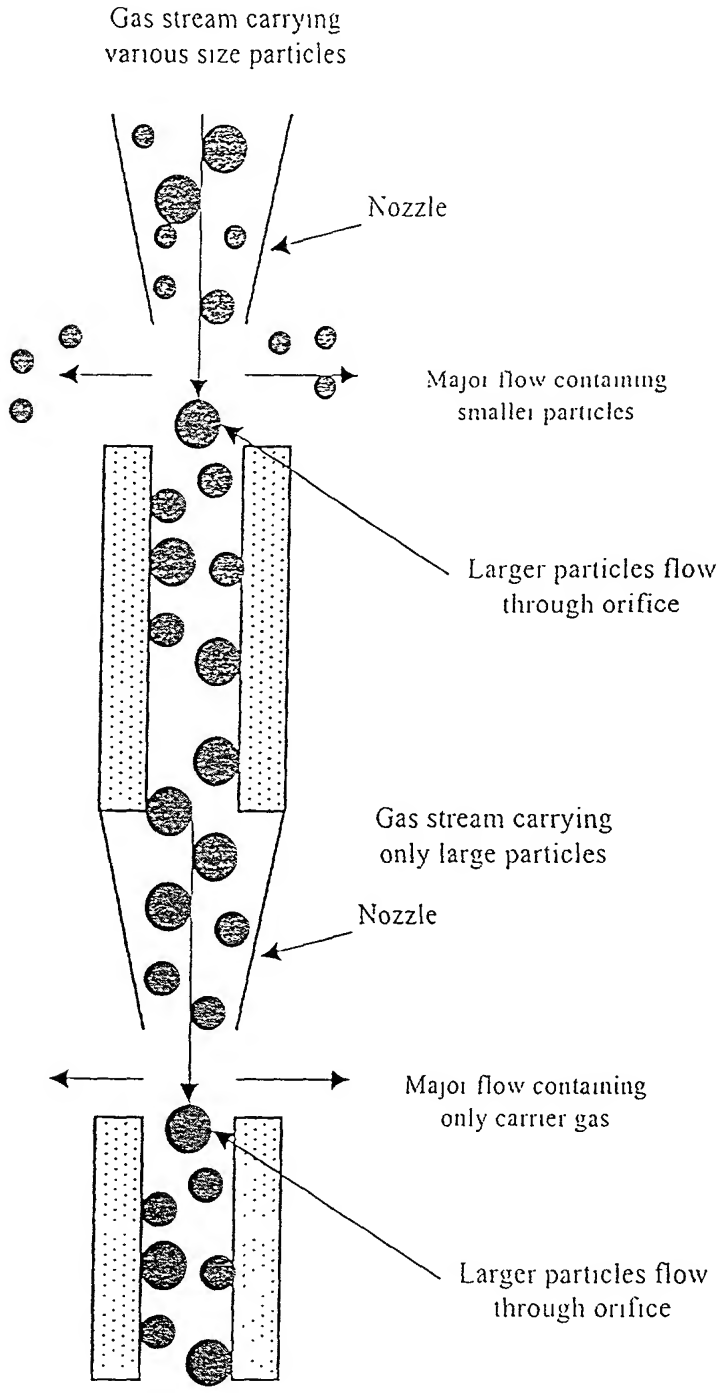


Fig. 8.

Particle Sorting at Atomization Unit
& Virtual Impactors in Series

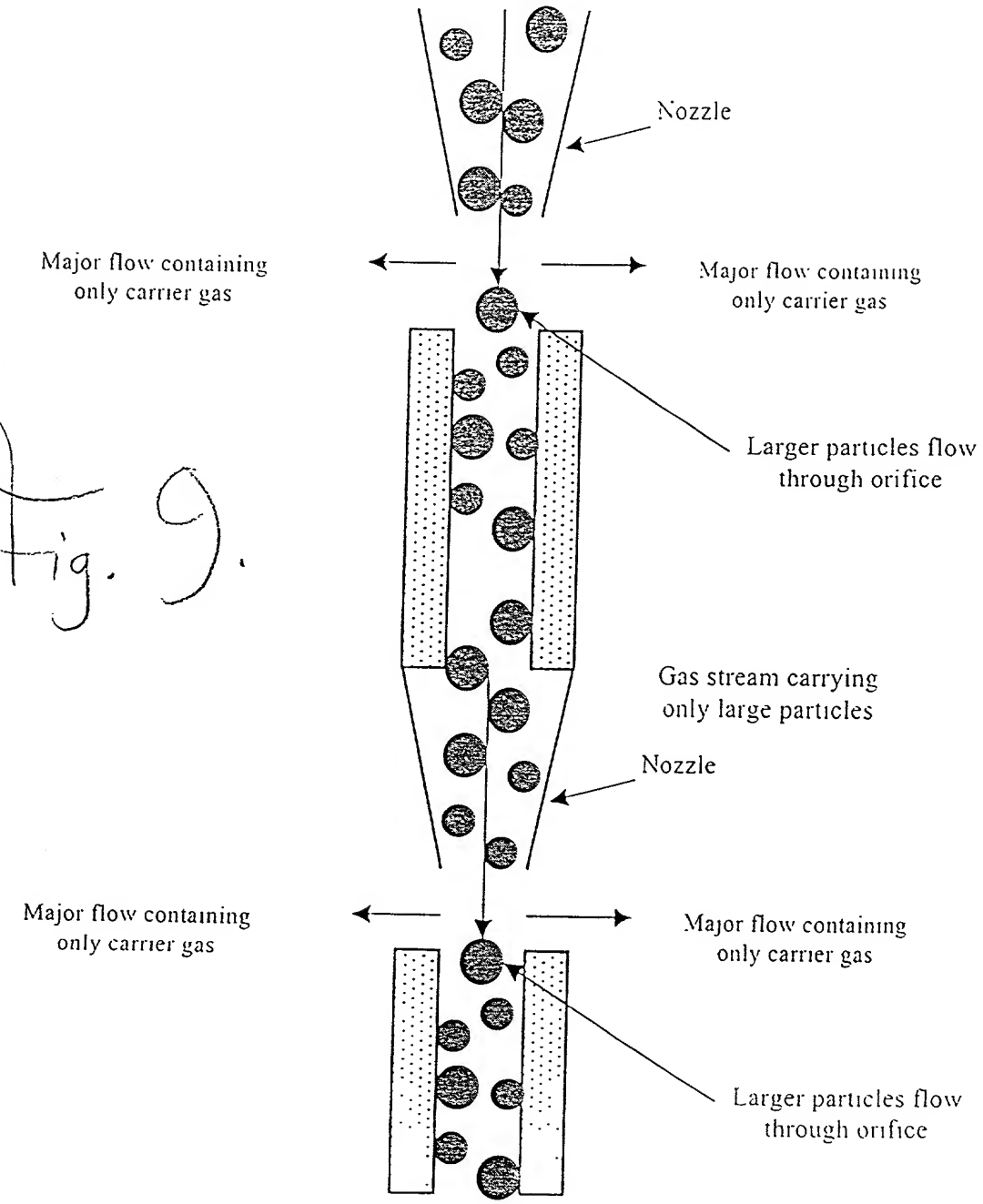
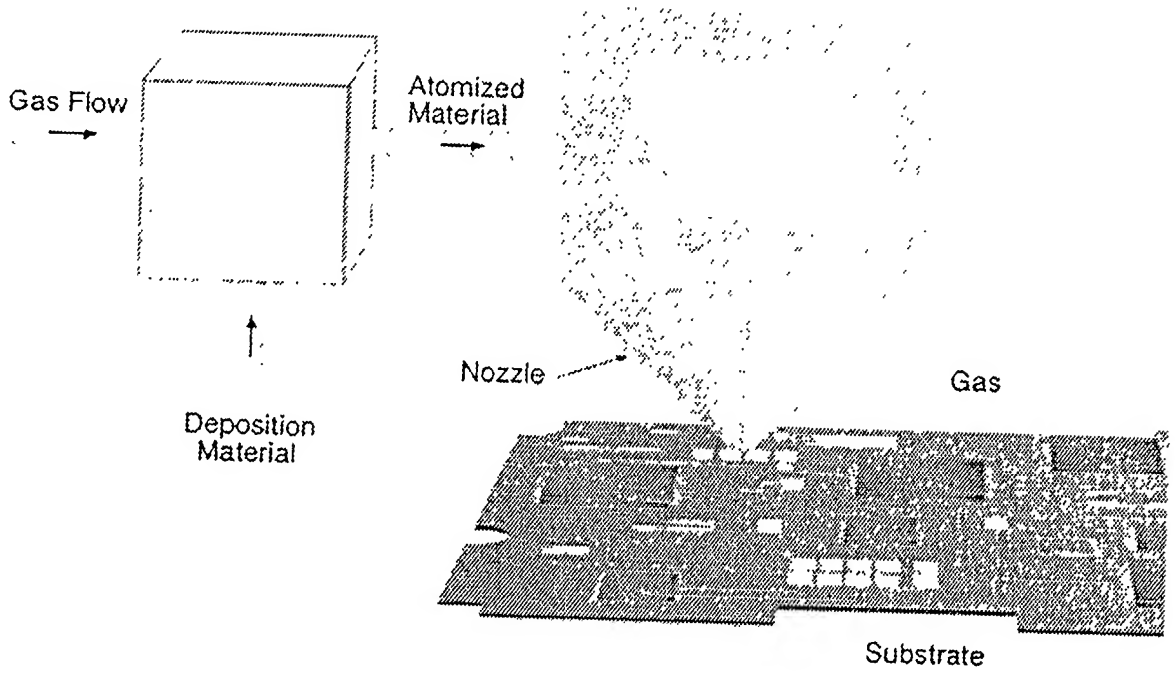


Fig. 9.

Fig. 10.

Flow Guidance Delivery System



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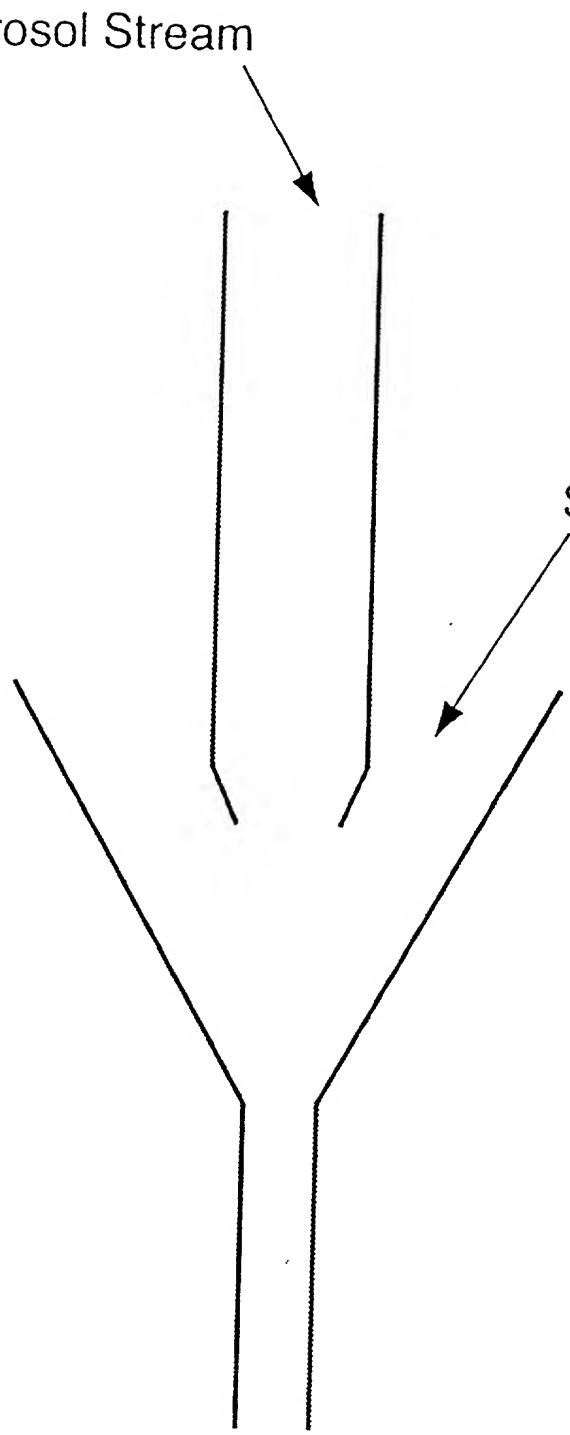
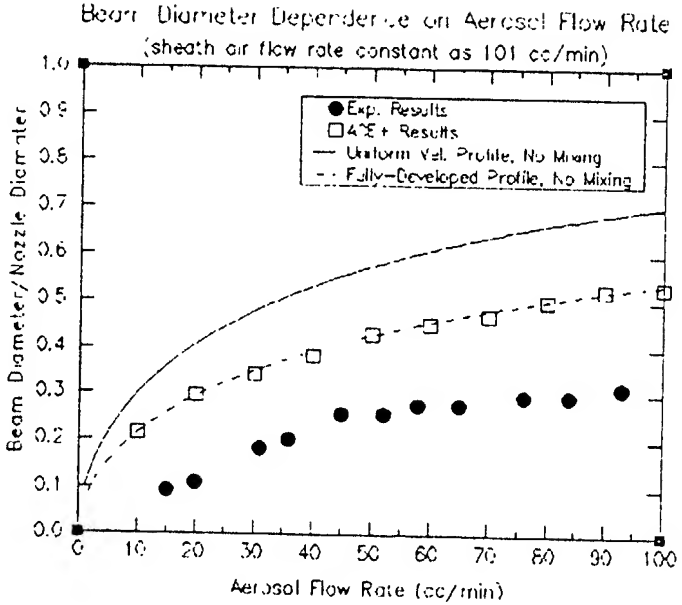


Fig. 11.

Fig. 12.


Beam Diameter Dependence on Aerosol Flow Rate
(sheath air flow rate constant as 101 cc/min)
Exp. Results
ACE+ Results
Uniform Vel. Profile, No Mixing
Fully-Developed Profile, No Mixing
Beam Diameter/Nozzle Diameter
Aerosol Flow Rate (cc/min)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
10
20
30
40
50
60
70
80
90
100

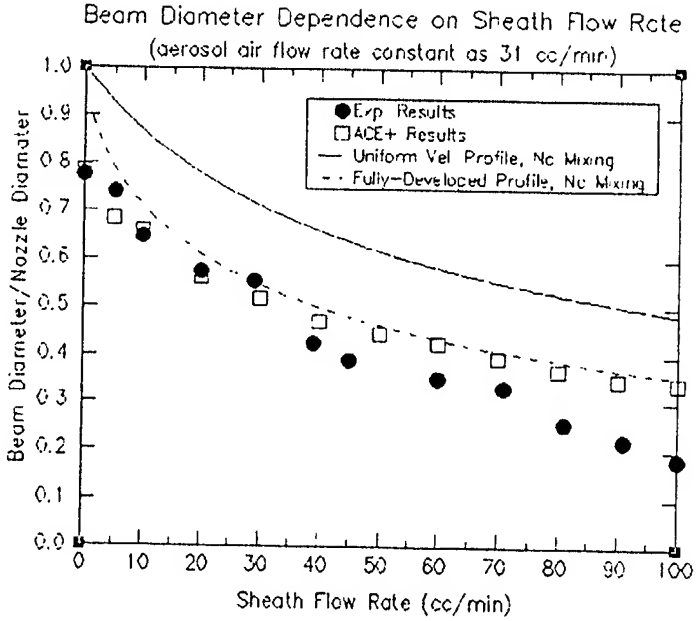

Beam Diameter Dependence on Sheath Flow Rate
(aerosol air flow rate constant as 31 cc/min)
Exp Results
ACE+ Results
Uniform Vel Profile, No Mixing
Fully-Developed Profile, No Mixing
Beam Diameter/Nozzle Diameter
Sheath Flow Rate (cc/min)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
10
20
30
40
50
60
70
80
90
100

Fig. 13.

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Fig. 14.

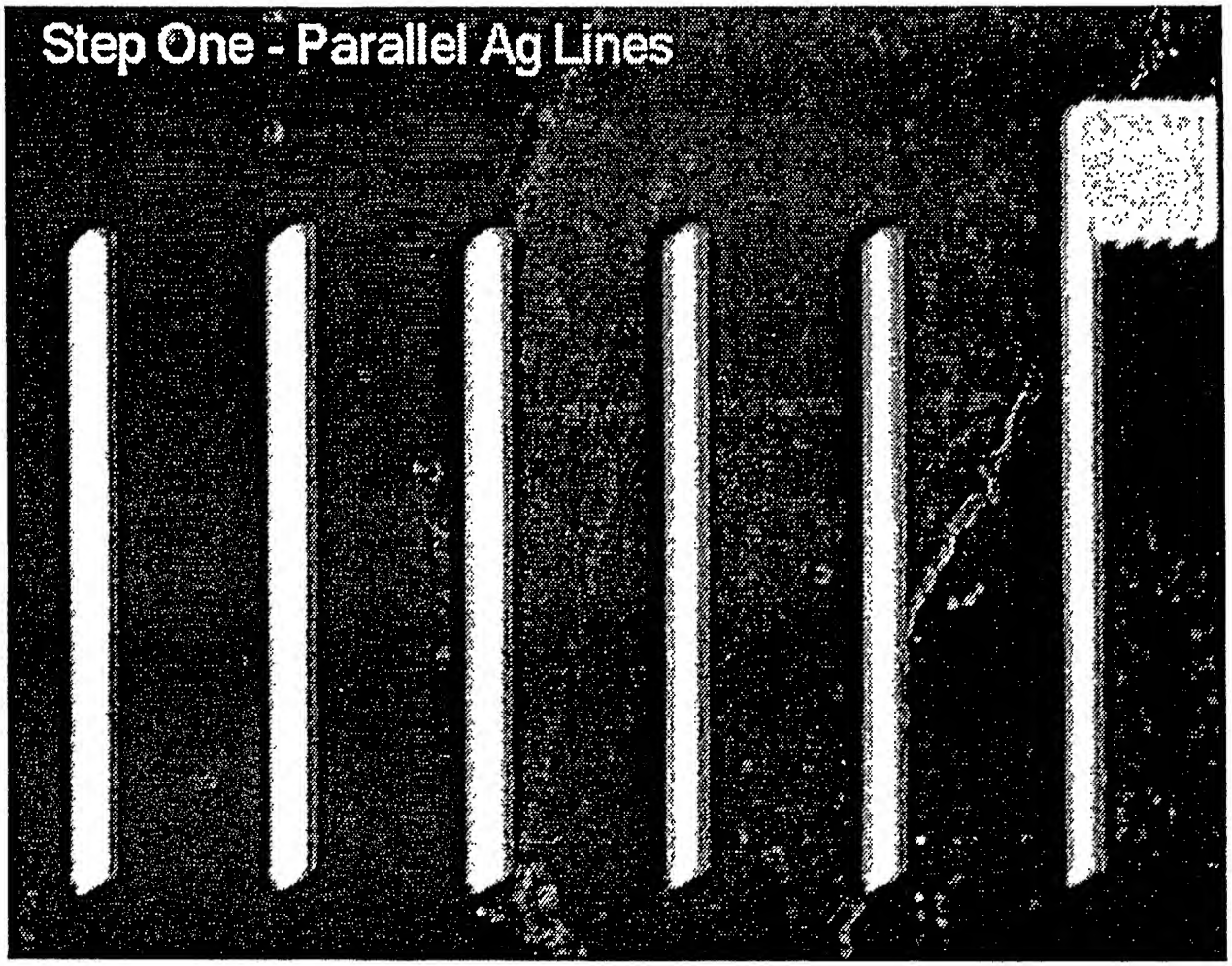


Fig. 15.

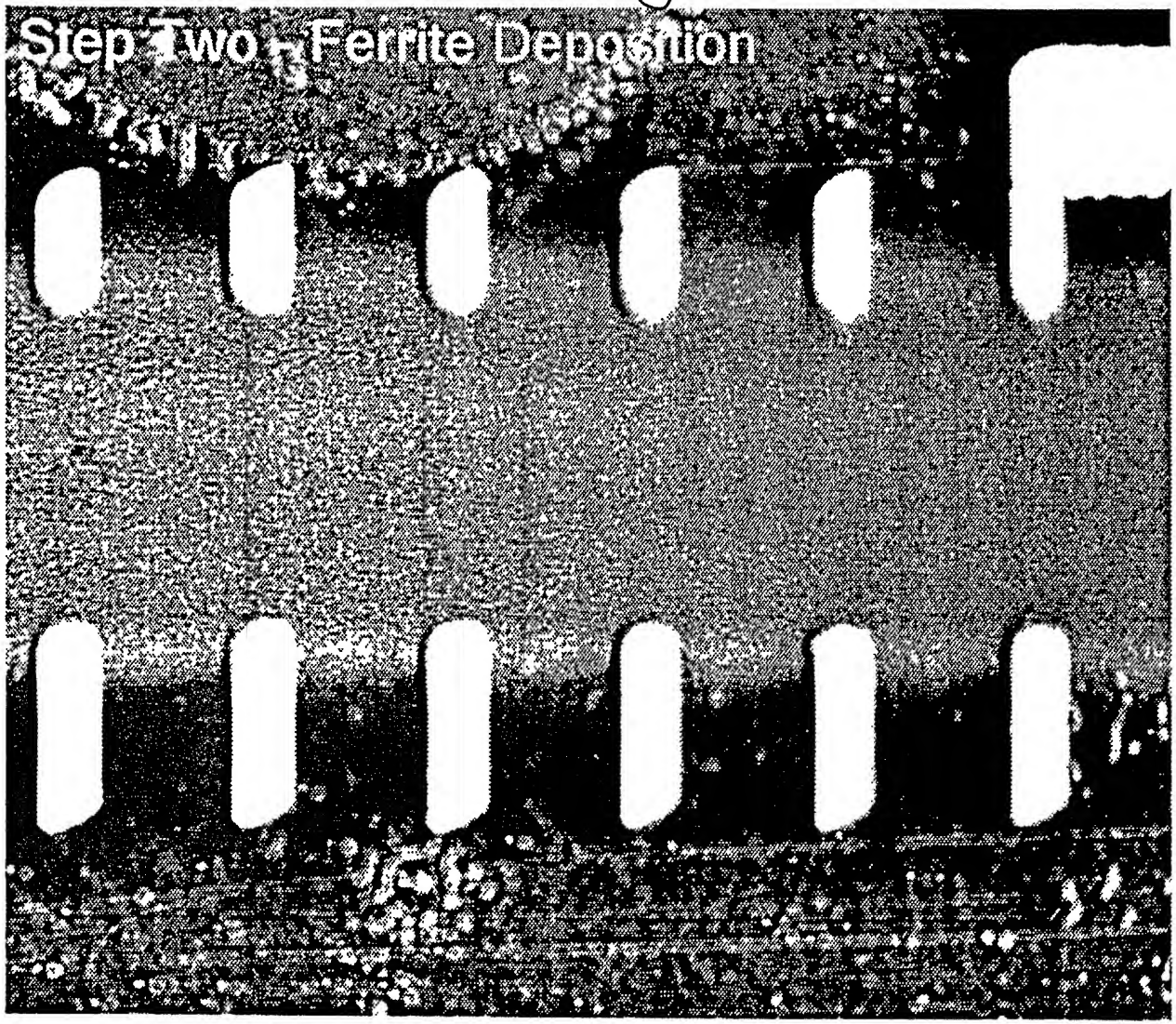
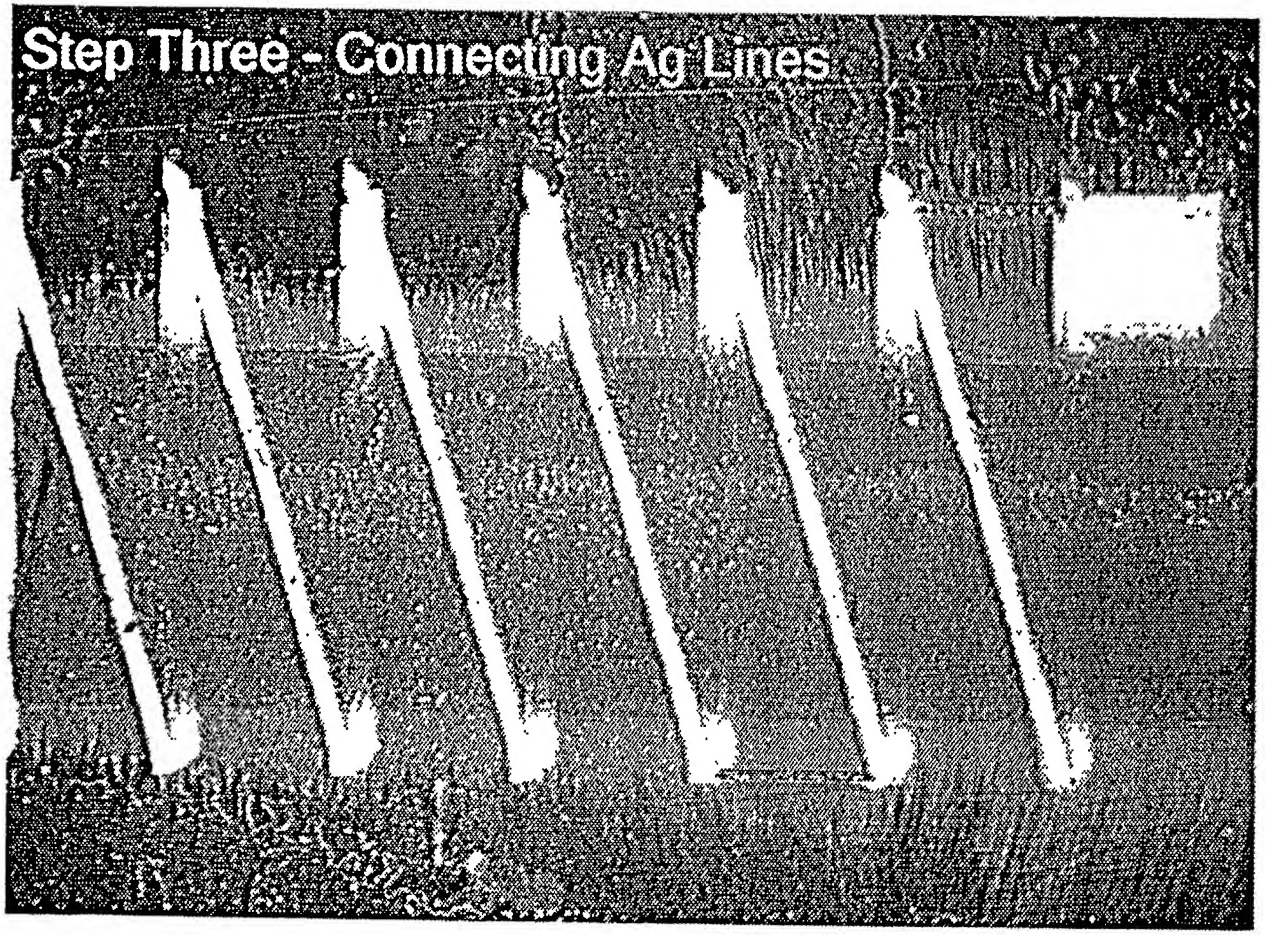


Fig. 16.



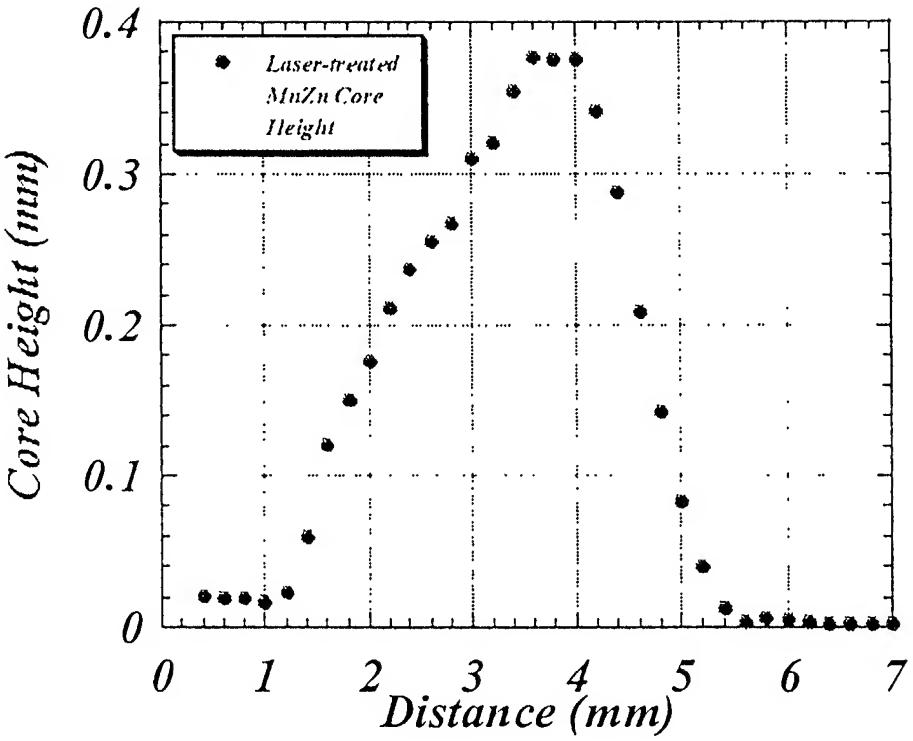

Laser-treated
MuZn Core
Height
Core Height (mm)
0.4
0.3
0.2
0.1
0
0
1
2
3
4
5
6
7
Distance (mm)

Fig. 17.